




Coastlab 10

BOOK OF ABSTRACTS



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Development of a test set-up to measure Wave-by-wave overtopping volumes

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INTRODUCTION

In the past twenty years, a lot of different concepts to extract energy from ocean waves have been tested, with variable outcome. One of these concepts links up with the expertise at the department of Civil Engineering at Ghent University (AWW-UGent): overtopping wave energy converters. These are based on wave run-up on a slope and overtopping into a reservoir that is emptied into the sea through turbines. When the water level inside the reservoir is kept as constant as possible, a buffer is created by the reservoir for the power output to be more constant. As a consequence, it would be interesting to be able to predict the water mass entering the reservoir wave-by-wave in order to anticipate the control strategy of the turbines. A test set-up has been designed that is able to measure individual overtopping volumes accurately to support the development of a prediction tool for non-floating sloped structures with a slope extending to the sea bottom.

METHODS

Test set-up version 1

A first test set-up was developed based on the measurement system for average overtopping discharges used at AWW-UGent (Beels, 2005) using a weigh cell recording the water mass in the reservoir (Fig 1) and a pump returning water back to the flume to compensate for its water loss through overtopping. Some refinements to this test set-up have been carried out in order to measure individual overtopping volumes more accurately (Victor):

- 1) The length of the chute has been shortened so that two overtopping waves with a very short time interval in between them can not merge in the chute towards the reservoir.
- 2) The reservoir and weigh cell are positioned as close as possible to the slope of the wave energy converter. The weigh cell and reservoir are positioned in a dry area inside the flume behind the slope.
- 3) A wave overtopping detection system is placed at the crest of the slope. It generates a voltage peak as a wave overtops the crest.

However, the test set-up as described above exposed some "children's diseases". The outlet of the pump was positioned near the slope and the incoming waves were disturbed by the water returning into the flume. The position of the overtopping detection system at the crest of the structure did not seem ideal. The time delay between water reaching the crest and reaching the reservoir is dependent on the size of the overtopping volume. Larger overtopping volumes reach the reservoir faster. As a consequence the automatic identification of the individual overtopping volumes was rather complex. Moreover, the pump did not have a return valve, which involved that for each pump event in fact a different pump curve had to be used to compensate for pumping.

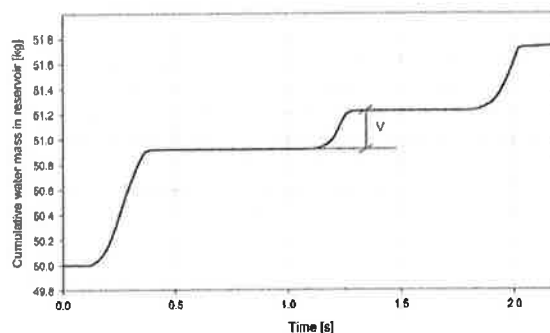


Fig. 1. Individual overtopping volumes can be determined from the increasing curve after pump compensation – cumulative water mass in reservoir.

Test set-up version 2

Following improvements have been carried out in version 2 of the test set-up (Fig 2):

- 4) The outlet of the pump was installed behind the dry area in which the reservoir and weigh cell are positioned. Water returns to the front of the slope below the dry area.
- 5) Two extra wave gauges were put to detect overtopping: one at the crest and one at the bottom of the chute.
- 6) The whole width of the flume was used in order not to disturb incoming waves.

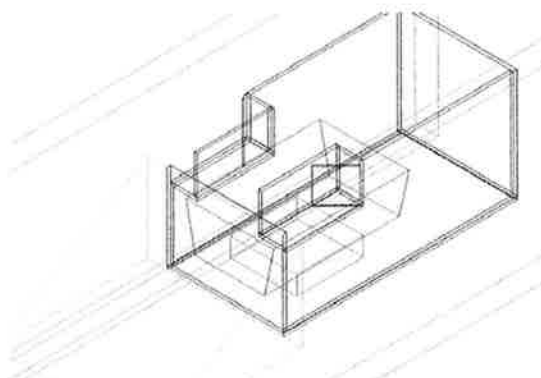


Fig. 2. CAD-drawing of the second test set-up, including the improvements.

RESULTS AND CONCLUSION

A comparison between both test set-ups has been made for their ability to measure the individual overtopping volumes accurately. The adaptations suggested in version 2 are improving the readability of the individual volumes.

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